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GRADUATE STUDY AND RESEARCH[1]

By Professor LUTHER P. EISENHART

PRINCETON UNIVERSITY

IN order to understand the present status of graduate study and research in this country it is advisable to review the development during the years. Although in some of our institutions there were graduate study and research before 1870, in the main our students went abroad for this purpose previous to that time. The organization of the Johns Hopkins University is generally regarded as marking the beginning of a new epoch in higher education in America. The conception on which it was founded was that there should be provided in Baltimore a place where young scholars attracted from various parts of the country might carry on advanced studies, particularly with reference to the development of scholarship and research. At the beginning the group was small and the professors were chosen solely with reference to the part they might play in this plan. There was no provision for advanced degrees. The subsequent institution of degrees has had fundamental bearing on the whole question under discussion.

Under the impulse to graduate study and research given by the Johns Hopkins University other institutions of the country began to make provision for them. In the main, these institutions had been concerned with collegiate education, and graduate schools as they developed became part of the same structure, like an upper story. In the past fifty years we have seen many such structures developed. Some institutions have distinguished between those who are teaching in the graduate school and those associated with the undergraduate school, but in many cases the same faculty members take part in the instruction of both groups of students. An advantage of the latter plan is that a larger group is concerned with advanced work, with the result that many of the younger members of the faculty are thus able to have their part in

[1] Founder's Day Address at Lehigh University, October 2, 1935.

it with resulting benefit to themselves and to the institution. The development of faculty personnel is an ever-present problem. If a young man is added to the staff because of his promise in scholarship as well as his ability as an undergraduate teacher, he must be given opportunity from time to time to develop his scholarship. Some of us older men find it hard to step aside in favor of younger men even on a scheme of rotation of courses.

A half century ago in the curriculum of the American college a continuing study of the classics and mathematics was considered fundamental. Following the introduction of the free elective system at Harvard and the changes in the curricula of the various colleges resulting therefrom, there grew up the conception that a college education consisted merely of a composite of credits received for courses taken, usually without any requirement that the knowledge of the content of these courses be carried beyond the semester in which a course was taken. Instead of the graduate school, by its presence on the same campus, exerting an influence in the direction of a university attitude toward undergraduate study, the college traditions were transmitted to the graduate school, with the result that graduate work in many places has been conducted along lines similar to that in the college where the question of credits rather than knowledge is paramount. We hear so often that a student has had for instance Eighteenth Century Literature or Medieval History but not that he has it now.

One frequently hears that there is no limit to the number of new courses introduced into the college curriculum, and that ordinarily courses are introduced not with reference to any well-thought-out plan of their relationship to the training of the student but because various members of the faculty desire to give particular courses. This observation frequently applies equally well to the graduate school. I question whether there is necessity for a great number of courses in any one subject provided they are organized relative to a plan and the courses are thought of as only part of the instructional system. Nor is it necessary that there be courses in every division of a subject but that whatever provision is made should be thought of in relation to what the graduate school intends its students to become. The student should acquire a certain mastery of his field, but this mastery should not be one of memory only. It is the development of his powers for further study and investigation with which the graduate school should be concerned. Whether in college or in university the idea seems to be that the institution is responsible for providing the student with a well-rounded and finished education rather than an orientation and beginning in his field for continuing study and development.

We are inclined to smile when a parent whose son has failed to qualify for the bachelor's degree says that his son has wasted four years, and yet is not that same attitude revealed with regard to graduate study, that is, should any one carry on graduate study unless he receives a degree for it? The parent feels that his son is entitled to a degree if he has spent four years in college, and one of the fundamental difficulties with graduate instruction is that the student feels that he is entitled to a degree if he has spent one or more years in advanced study. The degree of doctor of philosophy, as fundamentally conceived, should indicate that the bearer has acquired a mastery of his field of study and has shown that he has the capacity for independent research by producing a dissertation which enlarges or modifies what was previously known or presents a significant interpretation of his subject. This, however, is not the point of view frequently held. The degree is looked upon as representing the close of a certain process of advanced study rather than the sign that its bearer is prepared to start upon a scholarly career. Far too many candidates for this degree feel that it is the responsibility of those in charge of graduate instruction to see to it that they present an accumulation of material which in one way or another will be accepted as a dissertation. They feel the degree should be an award for earnestness and conscientiousness.

In my opinion the various accrediting agencies of the country, in determining whether a college should be put on the accredited list, have unconsciously had an unfortunate influence on graduate education. In determining whether a college has a suitable faculty, the conclusion is frequently given in terms of the number of Ph.D.'s and M.A.'s on the faculty. The effect of this process has been that college administrators insist that the members of their faculty have Ph.D's. If there is a professor of history, for example, who has been very successful as a teacher of undergraduates, but who does not have this degree, he is practically forced to get one. He proceeds to do it on the best terms possible. He attends a number of summer sessions to secure sufficient credits and then probably takes a year's leave of absence to write a dissertation on some subject ordinarily quite devoid of any relationship to his subsequent teaching. The professors in the graduate school to which he goes are expected to do all they can to have him accomplish his purpose. Thus, instead of devoting the year to a broadening and deepening of his knowledge, which would be of advantage to him in his teaching, he is merely trying to meet an artificial requirement. The presence in our graduate schools of many students who look upon the advanced degrees merely as a means of meeting such requirements, and not because they are

fundamentally interested in advanced scholarship, interferes seriously with the graduate school being an institution primarily for the development of men who are going to have an effective part in research.

A review of the careers of those who have received the degree of doctor of philosophy raises the question whether graduate study leading to this degree has as its fundamental purpose the development of men and women for a scholarly career. Recently there was an investigation by the Mathematical Association of America of those who received this degree in mathematics for a period of four or five years in the early twenties and as a result of this study the committee announced that it was a safe prediction that of those receiving this degree at present about 80 per cent. of them would never carry on any research of significance, although some may for a short time develop further the immediate subjects of their dissertations. No doubt all our journals would be overflooded if all our Ph.D.'s continued to produce articles. It has been suggested that this situation be corrected by two doctorates, one connoting knowledge and the other capacity for research. But here again we are trying to solve a problem by means of labels and not by judgment of men. It would be rash to conclude that all the 80 per cent. who have not published results of research had done their work in a perfunctory manner and did not profit by their years of advanced study. It may very well be that quite a number of them have continued to investigate, and more particularly have transmitted to their students an inquiring attitude of mind and thus are having a genuine part in the development of younger scholars.

The master's degree continues to be one of the big problems of the graduate school. There seems to be no general agreement as to what it should connote or what its purpose is. As a usual thing, it is granted for one year of study after the bachelor's degree, and the requirements for the degree generally consist merely of an accumulation of credits. There seems to be no intrinsic reason why a degree should be given for this study, but the degree has a certain commercial value, particularly with regard to those engaged in teaching in secondary schools. Some institutions look upon it as being a little doctor's degree and require a thesis. The writing of such theses may be all right, provided that they do not take too much time, but it is a question whether shorter papers in connection with seminars would not be more appropriate as a training for scholarship and research at this stage. When an institution has a large number of students presenting such theses the oversight and reading of them is likely to be very time-consuming for the faculty and not of very great value in themselves, and thus the time of the faculty is likely to be deflected from students more worthy of their assistance and from research on their own part which would be of more value for scholarship in general. The demand for the master's degree, largely because of its commercial value, has induced many colleges of the country to introduce a year of graduate study for which the degree is given. If a student is merely interested in the degree, I have no question to raise about the wisdom of the plan, but if a student is planning to go to a university for further graduate study, I question very much whether it is advisable for him to continue for a year at his own college. He is not likely to be associated with a group of able students interested in the same field, and he may fall into bad habits of study, if his teachers are so fully occupied with undergraduate instruction as not to be able to give him the proper attention.

In pointing out the drawbacks to a fuller realization of the purposes of a graduate school, I would not desire to give the impression that a great deal has not been accomplished in this country during these fifty years. In many fields the scholars of America are on the par with those of any other country. Many of our publications, whether as articles or treatises, rate in the first class. I am delighted to feel that the time is past when we should be apologetic about our scholarship, and I regret any evidence of such an attitude. It may have been appropriate years ago for us to give special consideration and place to European professors visiting this country. But that time has passed, and such consideration as may be shown should be because of the merits of the individual and not because he is a European.

Opportunities for advanced study and research by those holding the Ph.D. degree provided either by universities or the foundations have played an important part in the advancement of American scholarship. In particular, when one reviews the research which has been conducted by the National Research Fellows in the sciences during their years as fellows and subsequently, and the positions many of these men hold to-day, there can be no question of the value of this program. The Social Science Research Council and the Council of Learned Societies have likewise disbursed their funds to advantage. Here we have well-chosen students of ability given opportunities to continue study and research for its own sake and not with reference to degrees. The Institute for Advanced Study at Princeton is the embodiment of the original conception of the Johns Hopkins but at a higher level.

I have spoken of the effect of the college upon the university, and from the new developments that are now taking place in the colleges I believe there will come a better attitude toward study in the graduate schools. Many colleges are giving up the idea that

it is their function merely to teach the students and are realizing that they have the greater responsibility of training them how to educate themselves. Too long the colleges have had the idea that its students were not capable of directed study but that everything had to be explained and given to them. We are beginning to realize that our college students have unexpected potentialities for work of high quality and independence and that what the colleges have to do is to give them a responsible part in their own education. The conception of a degree as an indication that the student has merely satisfied the requirements of a set of isolated courses is being modified. We are proceeding slowly to this new point of view and even now many a college curriculum contains a great variety of courses introduced without reference to any well-thought-out plan of their relationship to the training of the student. If to the function of teaching there is to be added that of guidance, the faculties of our colleges will need more and more teachers who have the scholarly attitude and an understanding of research. This means that a teacher will be judged not by his degrees but by what he has become in the process of qualifying for these degrees. Undergraduates are capable of carrying on investigations of a subject and, in many cases where they are expected to do it, the students declare that it is the most interesting experience of their college career. The students must be under the guidance of men experienced in this technique. Even if the research which teachers are doing themselves is not fundamental or of great intrinsic merit, it may well be that its effect upon their attitude toward their students is of great value. Can a live teacher be keeping up in his subject without being faced with questions to be investigated and feel an irresistible urge to seek and to find?

A graduate school does not have to be big in order to be good, any more than it is good because it is small. It is not the question of a large variety of courses in any subject nor of the number of higher degrees granted. The fundamental question is what kind of scholars are produced. Education is not effected by legislation but by opportunity. Rules and restrictions limit the able and unduly encourage the mediocre. For in graduate work, as in many other human activities, "the letter killeth, but the spirit giveth life."

HOW TO VIEW THE SCIENCE MUSEUM

By Dr. F. B. JEWETT

PRESIDENT OF THE NEW YORK MUSEUM OF SCIENCE AND INDUSTRY

THE function of the New York Museum of Science and Industry is well stated in the paragraph from the will of Mr. Henry R. Towne. Mr. Towne saw the necessity in our mechanistic world of some agency capable of imparting to those who are not scientists and engineers an insight at once into the power as well as the limitations of technology when applied to the peaceful arts. The dynamic museum featuring both the history and the present status of science and industry seems clearly indicated as that agency.

Such museums are newest in the family of institutions devoted to display. That they are late comers is not because men have only recently had the wit to create them. It is because until recently science, both fundamental and applied, has not provided us with a sufficient panorama to make such a display especially significant. So long as the things of science and particularly those which entered into our daily lives were few and largely unrelated, it would have been difficult, if not impossible, to use them as exhibits in a museum of technology should be used. There would have been too many gaps to make the road plain to any except the expert.

However, because of the tremendous acceleration of scientific research during the past fifty years and the flood of new applications of science which has poured in on us in consequence, we have come recently to recognize that a great revolution is occurring. We find ourselves in a world where many of our most powerful tools are tools with which man has had little or no real experience. True, we know how to use them in a material sense, but as to their ultimate effect on our tribal affairs we are still quite in the dark. We have tried vainly to control them by consulting the experience bequeathed to us by the fathers and we have found that they would not be controlled by the wisdom of that experience alone. They were part and parcel of a new order which demanded a broader understanding on our part.

Fortunately for us, as new things have multiplied and new difficulties have arisen, it has become apparent that these revolutionary things of science in whatever field they may touch our lives are all branches of a common trunk and that if we would control the branches we must know something of the trunk. It is always easiest to reason accurately from the particular to the general. The mass of us must come to have some knowledge of certain fundamentals of science and the scientific relationships which control much of the world we live in, if as a group we are to

avoid chasing forever those perpetual motion phantoms which we have chased so often in the recent past. We don't need to become scientists or engineers to form a fair judgment on broad policy matters. We do, however, need to have some group understanding of the fundamental laws of, say, modern transportation machinery and of the further possibilities and limitations of the science which underlies it, if we are to set up satisfactory rules governing transportation in the national interest.

It was with the idea of facilitating the acquisition of this simple fundamental knowledge of science as applied to industry that the original Museum of Science and Industry was started. It was not designed as a place where people could see a great heterogeneous collection of marvelous scientific engines or processes and thereby satisfy a jaded curiosity. Nor was it designed as a place where those who would become skilled in some particular field of science or engineering could come and acquire all that they sought. In a word, the museum was not designed to be a substitute either for the circus or the college, technical school or university. It was designed as a place in which could be displayed in simple logical sequence some of the more important applications of science to industry and human intercourse.

In such a museum there are three main objectives underlying the exhibits: (1) To show clearly to the non-scientific person the fundamental principle which runs through every stage of development of a science application from its first primitive appearance to its latest refined embodiment; (2) To emphasize the fact that even this latest embodiment is but a transitory stage in a continuously expanding evolution; (3) So far as is now possible, to bring home to the non-scientific a realization that every department of science is devoted to the portrayal of a common nature. No sharp lines of demarcation exist and progress in every field is made by using the same mental processes and following the same rigorous course in proceeding from the known to the unknown.

These three objectives have the common purpose of seeking to impress vividly the idea that the applications of science involve something much more of concern to society than mere material results. At the present time we are so surrounded with amazing applications of science which we have not fully assimilated and the imminence of more is so great that the most elemental dictates of self-interest should impel us to the broadest possible group understanding of the possibilities and limitations of science. Without a much better understanding than we now have we will continue to be the victims of every crazy wind that blows—the dupes alike of ignorant or selfish politicians and of equally ignorant or selfish promoters. It will be a slow process at best and many educational methods will need to be employed. Among them museums of science and industry established where population is dense will be powerful agents—powerful because they can present essential matter simply and vividly; powerful because they can bring together in one place and in an orderly panorama the normally scattered elements of a common problem.

Turning now to the more immediate service which a museum of science and industry can be to the industrial area in which it is located, it can, I think, be taken as axiomatic that industry flourishes best and the community has the highest average standard of living where all who are concerned with industry, from the lowliest workman to the chief executive, have the highest average understanding of the problems involved in industry. If proof of this were needed one has only to turn to the very general establishment by technical industries of out-of-hour courses of instruction and other methods of making available to all employees elementary information about the technical parts of the business. Such courses are not established and maintained merely for the cultural enjoyment of those who take them, but rather because of a well-established belief that the industry and all concerned in it profit in a material way by raising the level of understanding.

While it is true that the introduction of intricate automatic machinery into countries of low intellectual development and low living standards has created a serious problem for countries where such machinery originated, it is equally true that the mere introduction of such machines does not establish complete parity. In countries like our own I feel convinced that in the years ahead we will have to do considerably more in the direction of broad industrial education, especially in those industries which have arisen out of the practical application of scientific research, if we are to maintain a spread in living standards compared to lower standard countries.

If this conclusion is valid and I think it is, then every industry which is concerned about its permanent well-being and, more particularly, every industrial community must be continuously on the alert to raise the average understanding of its people. There is no single method by which this can be done nor can it be done once and for all in a short time. Many tools must be employed and the process must be unceasing. Further, in a process so gradual we can rarely expect to notice sudden or marked improvements.

Among the educational tools to be employed museums of science and industry loom large because of the characteristics enumerated earlier. Every industrial community of sufficient size can well afford to maintain such a museum and every industry in the

community can afford to lend its support—both, if you wish, from the most sordid of material self-interest motives. Museums of this kind are the cheapest as well as the most effective way of disseminating certain kinds of basic information. Nor need the museums be of a common size or a common pattern. Each one can be fitted to the particular needs of its own community.

Further, no industry, large or small, can long escape being cited before the bar of public opinion as to some phase of its operations. When that time comes, if we feel we have a just case, we will wish for a public jury that has some understanding of our problems and not one moved wholly by its emotions.

Just now we are obviously in the midst of a revolution many of the roots of which are in the results of applied science. With most of the officially advocated proposals to rectify our situation and with the time elements talked of I am entirely out of sympathy. To me their proponents seem grossly ignorant of the economic forces inherent in applied science; of the limitations of human beings and their essential conservatism as to the established order of life no matter what they may do occasionally in periods of blind rage.

The waves of our present turmoil will not subside into the new order for years to come. In so far as the storm which created them involves the results of applied science, the oil of a wider understanding of what science can and can not do will accelerate the return to more quiet and prosperous conditions. In this a museum of science and industry can play a powerful rôle. In my judgment, we will get more of real value and results from this than from chasing phantoms of trying to turn the pages of life backward or of seeking plenty through destruction. To me such proposals are the proposals of ignorance and of a philosophy of defeatism which does scant justice to human intelligence.

OBITUARY

LEOPOLDO A. FAUSTINO

THE news of the untimely death on November 8, of Dr. Leopoldo A. Faustino, assistant director of the Bureau of Science in the Philippines and formerly geologist and paleontologist in the division of mines of that bureau, has just reached me, and I hasten to contribute a few words of appreciation of this Filipino scientist. Young Faustino was an assistant in the mining division when I was serving a second term of service as chief of that division in 1920–22. He had some years previously finished his undergraduate work at Ohio State, and realizing his promise, I urged him to go to Stanford University for work toward his doctorate. As Faustino was particularly interested in the corals of the Philippines, he was urged by the late Professor J. P. Smith to spend some time in Washington with Dr. T. Wayland Vaughan, who guided him in this special field. Finally his work on Philippine corals resulted in the doctor's degree at Stanford University.

His publications mark the first signal contributions by any one of his race to the geology of the Far East which have come to my attention. He was one of the foremost in that group of young Filipino leaders of a new order. Dr. Faustino had an unusual appreciation and understanding of the efforts being made by the United States in his native land, and of all the young men I knew over there, he more nearly thought and spoke like an American. He was singularly modest and conservative in his scientific opinions and was greatly liked by his American colleagues.

It is too early to appraise the work of Faustino and his Filipino associates, but we dare say that long after many of their more publicized compatriots have been forgotten, the influence of these young scientists, representatives of a new order in the Far East, will be felt.

I feel that the young Philippine commonwealth has suffered an untimely loss in the passing of this able young scientist, and I know that I have lost a genuine friend.

WARREN D. SMITH

RECENT DEATHS

DR. SAMUEL AVERY, research professor of chemistry at the University of Nebraska, died on January 25, at the age of seventy-one years. Dr. Avery was chancellor of the university from 1908 to 1927. Previously he had been professor and head of the department of chemistry.

DR. ELWOOD MEAD, since 1924 U. S. Commissioner of Reclamation, died on January 26, at the age of seventy-eight years.

DR. GEORGE GELLHORN, professor of clinical obstetrics at the School of Medicine of Washington University, St. Louis, died on January 25, at the age of sixty-five years.

THE death is announced on January 18, at the age of sixty-one years, of Dr. Hollis Godfrey, consulting engineer, of Duxbury, Mass. From 1906 to 1910 Dr. Godfrey was head of the department of science in the School of Practical Arts in Boston and from 1913 to 1921 president of the Drexel Institute, Philadelphia.

DR. CAROLINE E. FURNESS, professor of astronomy at Vassar College and director of the observatory, died on February 9. She was sixty-six years old.

DR. W. J. TAYLOR, chief of staff of attending surgeons at the Philadelphia Orthopedic Hospital and Infirmary for Mental Diseases, died on January 22, in his seventy-fourth year.

DR. GEORGE ALBERT MENGE, associate professor of chemistry at Lafayette College, died suddenly on February 3. Dr. Menge was born at Buffalo, New York, on December 18, 1874. He graduated from the Sheffield Scientific School of Yale University in 1903, receiving his Ph.D. degree in 1906. He was instructor at Yale from 1903 to 1907. He was technical assistant in the U. S. Hygienic Laboratories from 1909 to 1914, during which time he was also professor of chemistry at Georgetown University. From 1914 to 1917 he was research chemist in the Dairy Division of the Bureau of Animal Industry of the U. S. Department of Agriculture. He engaged in consulting service for food industries from 1917 to 1924, becoming a member of the faculty at Lafayette College in 1924. There he had charge of the work in general chemistry and also of the course in industrial chemistry. Dr. Menge published in the chemical, biological and pharmaceutical journals many papers.

DR. CHARLES WARREN HOOPER, director of research medicine and chief of the biologic laboratories of the Winthrop Chemical Company, died in Albany, N. Y., on January 27. He was born in Great Bend, Kansas, in 1890, graduated with the degree of A.B. from the University of Kansas in 1911, and of M.D. from Johns Hopkins Medical School in 1914. Shortly after his graduation he was appointed assistant professor of research medicine of the Hooper Foundation, and from 1918 to 1921 served as pathologic physiologist in the Hygienic Laboratory of the United States Public Health Service. Thereafter he became director of research medicine and chief of the biologic laboratories of H. A. Metz Laboratories, which was later absorbed by the Winthrop Chemical Company. Dr. Hooper was the author of works on the function of the liver in relation to anemia, local anesthetics, hypnotics, arsenicals and vitamins.

SCIENTIFIC EVENTS

THE PHILADELPHIA COLLEGE OF PHARMACY

AT the Philadelphia College of Pharmacy and Science on January 31, as part of the annual conferences and exhibits, the new Remington Memorial Laboratories were dedicated. The installation and equipment of these laboratories was made possible by the generosity of Josiah K. Lilly and Eli Lilly, Indianapolis pharmaceutical manufacturers, who are both graduates of the Philadelphia College.

At the evening program which followed the dedication, Dr. William Bosworth Castle, associate professor of medicine at Harvard University, received from the Philadelphia College the Procter Award in recognition of his notable contributions to the therapeutics and treatment of pernicious anemia. Dr. Castle addressed the meeting on recent developments in this field.

The significant features of the new Pharmacopoeia were outlined by Dr. E. Fullerton Cook, chairman of the United States Pharmacopoeia Committee of Revision, and those of the new National Formulary by Dr. Adley B. Nichols, secretary of the N. F. Committee of Revision. At the afternoon meeting, before the dedication of the new laboratories, the chemical features, the biological features, the pharmacognosy and the pharmacy of the new United States Pharmacopoeia were discussed by faculty members.

In addition to the exhibition of the new laboratories in operation, there were exhibits at the college showing various types of medicines and methods of preparing them. The model pharmacy which has been used a number of years at the Philadelphia College as a demonstration laboratory has been completely rearranged and was thrown open for the first time. The resulting rearrangement has created two model pharmacies. One illustrates the arrangement and equipment of a pharmacy devoted exclusively to the compounding of prescriptions and other professional services of pharmacy. In the other model pharmacy, the professional services of pharmacy are emphasized, but provision is made for the sale of other classes of merchandise customarily sold in drug stores.

THE RETIREMENT OF PROFESSOR HERBERT E. GREGORY

DR. HERBERT E. GREGORY, Silliman professor of geology at Yale University and director of the Bernice P. Bishop Museum at Honolulu, will retire from active teaching at the end of the present academic year. He will be succeeded by Dr. Peter H. Buck, who has been for the past two years Bishop Museum professor of anthropology at Yale, and who is known for his scientific investigations in the Polynesian Islands. Dr. Buck has been appointed director of the museum and professor of anthropology at Yale.

The Bishop Museum and Yale University are affiliated for the purpose of broadening the scientific re-

search program of both the museum and the university in the Pacific Ocean region. The museum was founded in 1889 and is devoted to the study of anthropology and natural history of the Pacific Islands, comprising some 25,000 scattered over an area equal to about one fourth of the earth's surface. Under the terms of affiliation the director of the museum is a member of the Yale faculty, and the university provides annual fellowships, available to advanced students for research in this region. In addition the museum sends to Yale a visiting lecturer to give instruction and direct research in the problems of the Pacific area. Dr. Edward S. C. Handy is this year's visiting lecturer.

Dr. Gregory, who has been a member of the faculty of the university since 1896 when he received the B.A. degree, was appointed Silliman professor of geology in 1904. In 1919 he went to Hawaii to assist in formulating plans for the development of scientific work in the museum, was made director in 1920, and has since spent the greater part of his time in Hawaii. He has been an associate editor of the *American Journal of Science,* and is a fellow of the Geological Society of America, the Association of American Geographers, of which he was president in 1920, and the American Academy of Arts and Sciences.

At different times he has spent the summer working for the U. S. Geological Survey in various parts of this country. He devoted several summers to improving the living conditions of the Navaho and Hopi Indians in the desert regions of Arizona and Utah. In 1923 he organized and directed the Pacific Science Congress which met in Australia.

Under his directorship, many expeditions have gone out to remote islands and have collected hitherto unknown materials in the field of ethnology. The first was the Dominick Expedition, made possible through the generosity of Bayard Dominick, '94, which spent two years in the field with a view to ascertaining the origin of the Polynesian race. Later, through a cooperative arrangement with the American Museum of Natural History, the Bishop Museum participated in the Whitney South Seas Expedition.

A major project planned by Dr. Gregory was the Mangarevan Expedition, which explored the eastern border of Polynesia. This expedition completed the reconnaissance survey of the ethnology and natural history of this area, which has been the chief interest of the museum since he became director.

AWARD OF THE CHANDLER MEDAL TO PROFESSOR GIAUQUE

THE Chandler Medal of Columbia University for 1935 has been awarded to Dr. William Francis Giauque, professor of chemistry at the University of California, for his work in thermochemistry. The medal was instituted in 1910 by friends of the late Charles Frederick Chandler, pioneer in industrial chemistry, a founder of the American Chemical Society and professor at Columbia University for more than half a century. The award was established with a gift which constitutes the Chandler Foundation. Previous medalists include Irving Langmuir, James Bryant Conant, George O. Curme, Jr., Leo H. Baekeland, W. F. Hillebrand, W. R. Whitney, R. E. Swain, E. F. Smith, E. C. Kendall, S. W. Parr, Moses Gomberg and J. A. Wilson.

The announcement of the Medal Committee, of which Professor Arthur W. Thomas, of Columbia University, is chairman, reads:

Professor Giauque, in collaboration with Professor H. L. Johnson, of the Ohio State University, reported, in 1929, their discovery of the new isotopes of oxygen having masses of 17 and 18, respectively. Up to that time it was supposed that the lighter elements such as oxygen, nitrogen and carbon consisted of single varieties. The only isotope of oxygen then known had a mass of 16.

Following their research it was discovered that nitrogen had more than one isotope, and then that carbon had more than one. Due to the fact that oxygen is the standard for atomic weights, it became evident that the atomic weight of hydrogen was not correct.

Prediction of an isotope of "heavy hydrogen" having a mass of 2 was made by Birge and Menzel on the basis of Professor Giauque's work, but evidence was lacking. This prediction led Professor Urey, Dr. F. G. Brickwedde and Dr. George M. Murphy to look for the new isotope, resulting in the discovery for which Professor Urey received the Nobel Prize in 1934.

Professor Giauque has made many significant contributions to experimental methods in thermodynamics. His most extensive investigations have consisted in the extremely accurate determination, from 0.24 degrees absolute, to room temperature, about 300 degrees absolute or 27 degrees centigrade, of the specific heats and heats of transition of hydrogen chloride, hydrogen bromide, hydrogen iodide, oxygen, nitric oxide and hydrogen. From these determinations he has calculated the entropy, or amount of heat energy not available in reactions, of each of these gases. Entropy values are of particular importance to the chemist because with them he can determine the maximum energy to be secured from a given reaction.

Professor Giauque has measured the heat, or energy capacity of each gas from the lowest temperature obtainable all the way up to room temperature. He has also been the first to calculate from spectroscopic data for the same gases entropy values which are even more accurate than those based on the measurements of specific heats.

By Professor Giauque's method of obtaining low temperatures through the use of a magnetic engine, a temperature of a few thousandths of a degree absolute can be reached, while the lowest reached by other methods

was 0.7 degrees absolute. While thermodynamic theory, to which Professor Giauque has contributed extensively, indicates that it is impossible to reach absolute zero, Professor Giauque's method has enabled scientists to come closer to it. These low temperature data are of great significance in supplying data for the calculation of chemical equilibria.

Professor Giauque also demonstrated the predicted existence of the ortho and para forms of hydrogen by finding a change in the melting points of hydrogen, after standing for a long time in the form of liquid hydrogen. This research deals with the rotational energy levels of hydrogen and indicates that hydrogen in different rotational states can be partially separated and has different properties.

In 1929 Professor Giauque shared with Professor H. L. Johnson the prize of the Pacific Division of the American Association for the Advancement of Science for the most important scientific contribution reported by a resident of the Pacific Division for their discovery of the two new isotopes of oxygen announced at the meeting.

GRANTS OF THE GEOLOGICAL SOCIETY OF AMERICA

RECENT grants made by the Geological Society of America in furtherance of research are as follows:

$450, to George W. Bain, Amherst, Mass., field expenses connected with the measurement of the strains of recently exposed quarry floors.

$165, to G. O. Raasch, Madison, Wis., office and field expenses connected with completion of manuscript on Cambrian Merostomata of the Upper Mississippi Valley.

$400, to William F. Jones, Nantucket, Mass., field and office expenses in completing an investigation into the post-Glacial coastal evolution of the southeastern New England province from Boston to Narragansett Bay.

$3,500, to a committee headed by T. S. Lovering, Ann Arbor, Mich., investigation of the physical chemistry of the two-component volatile system, carbon dioxide and water, under varying pressures in equilibrium with a silicate melt at a constant temperature of 1000°.

$975, to Eleanora B. Knopf, New Haven, Conn., field and laboratory expenses connected with an intensive study of structure, stratigraphy and metamorphic geology of the Clove-Millbrook quadrangles, New York and Connecticut, by the methods of structural petrology (petrofabrics).

$900, to Horace G. Richards, Trenton, N. J., field and laboratory expenses connected with a study of marine Pleistocene deposits of the Gulf Coastal Plain from Alabama to Texas and correlation with the loess deposits of the lower Mississippi Valley.

$300, to Lloyd W. Fisher, Lewiston, Me., laboratory expenses of study of certain problems of the Lewiston quadrangle.

$2,500, to Alfred C. Lane, Cambridge, Mass., chemical analyses covering studies of the age of rocks by the helium method.

$450, to B. L. Miller and Maurice D. Ewing, Bethlehem, Pa., additional grant to cover field expenses, equipment, assistance and supplies connected with seismic work on the eastern Continental Shelf.

$1,475, to G. H. Anderson and J. H. Maxon, Pasadena, Calif., field and laboratory expenses connected with study of the structure and petrology of the Northern Inyo Range, California and Nevada.

$500, to Harrison Schmitt, Hanover, N. Mex., laboratory expenses connected with study of the geology of the central mining district, Hanover, N. Mex.

$975, to A. C. Waters, Stanford University, Calif., field and office expenses connected with study of plutonic and metamorphic rocks in the Chelan and Okanogan regions of central Washington.

$1,000, to Herman Schlundt, Columbia, Mo., field expenses of investigations of radioactivity of spring deposits and spring waters in some of the national parks.

$600, to Francis P. Shepard, Urbana, Ill., field and office expenses connected with the compilation of a map of submarine topography of the Continental Shelf and slope off the California coast.

$200, to Bohumil Shimek, Iowa City, Ia., office expenses connected with the preparation of a manuscript on the fauna of the Mississippi Valley loess and its significance as an indicator of conditions during deposition of the loess.

$800, to G. A. Cooper, Washington, D. C., photographic expenses connected with monograph of the Chazyan brachiopods of North America, by E. O. Ulrich and G. A. Cooper.

$300, to Guy Campbell, New Albany, Ind., field and office expenses connected with study of the New Albany and related black shales of Indiana and Kentucky.

$1,500, to Frank F. Grout, Minneapolis, Minn., to guarantee part of the expenses for a petrographic-chemical laboratory at the University of Minnesota.

$810, to H. B. Washburn, Jr., Cambridge, Mass., traveling and field expenses connected with study of movement of glacier ice (South Crillon Glacier, Alaska).

$209, to Alonzo Quinn, Providence, R. I., covering analyses of igneous rocks from Red Hill, New Hampshire.

$250, to Charles H. Behre, Jr., Evanston, Ill., additional grant to cover traveling, field and laboratory expenses, examination of the geologic setting of the great depression of the South Park, Colorado.

$2,500, to the Board of Trustees of *Biological Abstracts*, Philadelphia, Pa., editorial expenses work on paleontology.

$1,740, to T. Wayland Vaughan, La Jolla, Calif., assistance, traveling and office expenses, connected with completion of a revision of the madreporarian Hexacoralla.

$1,200, to Robert T. Hill, Dallas, Tex., additional grant, covering expenses connected with history of geologic investigation in the Southwest.

$450, to Frank D. Adams and F. F. Osborne, chemical

analyses connected with completion of a study of the Morin anorthosite area, Quebec.

THE NEW YORK MUSEUM OF SCIENCE AND INDUSTRY

CEREMONIES opening the new permanent home of the New York Museum of Science and Industry in Rockefeller Center were held on the evening of February 11. Sir William Bragg, director of the Royal Institution of Great Britain, formally opened the museum from the desk at which Michael Faraday worked out his experiments in electro-magnetism. Seated in Faraday's chair, Sir William lighted a match and candle which sent an impulse over the Atlantic. Picked up in New York through a photo-electric cell, the impulse lighted a small incandescent lamp within the museum, the first lamp manufactured by the Westinghouse Company. In turn, the original lamp lighted a battery of forty new mercury vapor lamps.

Sir William Bragg preceded his formal opening of the museum with an address. Other speakers were Dr. Frank B. Jewett, president of the Bell Telephone Laboratories and president of the Board of Trustees of the Museum; Dr. Albert Einstein; Dr. Harold C. Urey, professor of chemistry at Columbia University; and Mayor La Guardia. Dr. Robert A. Millikan, of the California Institute of Technology, spoke from Pasadena, and Miss Amelia Earhart from Santa Ana, Calif.

The museum, which was established in 1927 through a bequest of Henry R. Towne, seeks in exhibits, many of which can be operated by visitors, to make the underlying principles of science more understandable to the layman and to depict recent developments in science and industry, tracing them to their scientific origins. Five special exhibits, demonstrating notable achievements in science, have been arranged by the laboratories of the General Electric Company, the B. F. Goodrich Company, the Bell Telephone Laboratories, the Eastman Kodak Company and the New York Central Railroad.

The museum has more than 50,000 square feet of exhibition space in Rockefeller Center. The Rockefeller Foundation and the Carnegie Corporation have each given $20,000 a year for its support. The following have been added to the Board of Trustees: Gerard Swope, president of the General Electric Company; Thomas J. Watson, president, International Business Machines Company; Newcomb Carlton, chairman, Western Union; Edward R. Stettinius, Jr., chairman of the finance committee of the United States Steel Corporation, and Nelson A. Rockefeller.

SCIENTIFIC NOTES AND NEWS

SIR FREDERICK GOWLAND HOPKINS, Sir William Dunn professor of biochemistry at the University of Cambridge and retiring president of the Royal Society, will be visiting professor at Harvard University during the coming academic year. While at Harvard he will deliver the Edward K. Dunham lectures at the medical school.

THE fourteenth award of the Faraday Medal of the Institution of Electrical Engineers, London, has been made to Sir William Bragg, Fullerian professor of chemistry at the Royal Institution and director of the Davy-Faraday Research Laboratory. The medal is given "not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality."

THE gold medal of the Royal Astronomical Society for 1936 has been awarded to Professor H. Kimura, since 1899 director of the International Latitude Observatory at Mizusawa, Japan. Professor Kimura has devoted the major part of his activities to a study of the variations of latitude and, since 1919, he has been president of that commission in the International Astronomical Union. His principal discovery relates to the existence of a small variation that is constant with respect to the longitude of the station, but which varies with its latitude.

A BRONZE bust of Colonel William L. Keller, until recently head of the surgical service at Walter Reed General Hospital, Washington, D. C., has been installed in the entrance lobby of the main building of the institution, as a gift of Brigadier General Hugh S. Johnson. Colonel Keller was retired from active duty on October 31 and was made surgical consultant under a special law enacted on May 15.

DR. G. H. PARKER, professor of zoology emeritus at Harvard University, has been elected to honorary membership in the New York Academy of Sciences.

DR. L. C. STRONG, of the Yale University Medical School, has been made a foreign corresponding member of the French Association for the Study of Cancer.

THE honorary fellowship of the Jewish Academy of Arts and Sciences, New York, was conferred on January 26 on Dr. Morris Fishbein, editor of the *Journal of the American Medical Association*. Dr. Fishbein gave the principal address.

PROFESSOR J. W. ALEXANDER, of the Institute for Advanced Study, Princeton, has been appointed Rouse

Ball lecturer in mathematics at the University of Cambridge for the present academic year.

Officers of the Academy of Science of St. Louis for 1936 have been elected as follows: *President,* Dr. Robert J. Terry; *First Vice-president,* Dean A. S. Langsdorf; *Second Vice-president,* The Rev. Jas. B. Macelwane, S.J.; *Directors* (2), H. E. Wiedemann and John J. O'Fallon; *Corresponding Secretary,* Dr. Albert Kuntz; *Treasurer,* C. H. Philpott; *Librarian,* Dr. E. P. Meiners; *Curators* (3), W. F. Shay, Dr. L. F. Yntema, Professor P. E. Kretzmann; *Recording Secretary,* Professor W. D. Shipton.

Officers of the Pathological Society of Philadelphia elected for 1936 are: *President,* Dr. Esmond R. Long; *Vice-president,* Dr. Baxter L. Crawford; *Secretary-Treasurer,* Dr. Herbert L. Ratcliffe.

Dr. Ralph E. De Lury, assistant director of the Dominion Observatory, Department of the Interior, Ottawa, was elected president of the Royal Astronomical Society of Canada at the annual meeting held at the University of Toronto on January 14. Vice-presidents elected were Dr. William Findlay, professor of mathematics in McMaster University, Hamilton, Ontario, and Dr. J. A. Pearce, of the Dominion Astrophysical Observatory, Victoria, British Columbia.

Fred W. Morse, who retired last month as research professor of chemistry at the Massachusetts State College, has been elected emeritus research professor of chemistry by the trustees of the college.

Dr. Alden B. Dawson, associate professor of zoology, has been appointed director of the Harvard Biological Laboratories, to succeed Dr. Alfred C. Redfield, professor of physiology, whose resignation as director of the laboratories took effect at the beginning of the academic year. Professor Redfield is continuing his work in teaching.

Dr. William G. Colby, assistant agronomist with the Soil Conservation Service of the U. S. Department of Agriculture and previously research assistant in agronomy at the New Jersey Agricultural Experiment Station, has been appointed research professor of agronomy at the Massachusetts State College.

Professor Norman W. Krase, of the University of Illinois, has been appointed associate professor of chemical engineering at the University of Pennsylvania, beginning on July 1. He will give special attention to further development of the course in chemical engineering, together with graduate instruction.

Dr. Cecil Percy Martin, university anatomist and chief demonstrator in anatomy in Trinity College, University of Dublin, has accepted the Robert Reford professorship of anatomy in the faculty of medicine of McGill University. He will take up the work in September, filling the vacancy created by the resignation of Dr. S. E. Whitnall in December, 1934, to accept the chair of anatomy at the University of Bristol.

Charles Galton Darwin, Tait professor of natural philosophy in the University of Edinburgh, formerly fellow of Christ's College, Cambridge, has been elected to the mastership of the college on the retirement of Norman McLean. Professor Darwin is a son of the late Sir George Darwin and a grandson of Charles Darwin.

Professor Lacassagne, of the Institute of Radium in Paris, is expected to arrive in the United States on March 9. He will be the guest of the International Cancer Research Foundation and of the Fuller Fund. He plans to visit Chicago and Saint Louis on his way to the Pacific Coast, and to return in time to attend the annual meetings of the Federation of American Societies for Experimental Biology in Washington and of the American Association for Cancer Research in Boston.

The Joseph Henry lecture of the Philosophical Society of Washington was given on February 1 by Dr. Herbert Dingle, assistant professor of astrophysics at the Imperial College of Science and Technology, London. He spoke on "The Physical Universe."

The third annual lecture in the E. Starr Judd lectureship in surgery, established at the University of Minnesota by the late Dr. E. Starr Judd, will be given on March 17 in Minneapolis by Dr. Frank C. Mann, professor of experimental surgery in the Mayo Foundation. The subject of the lecture will be "Hepatic Physiology and Pathology from the Surgical Viewpoint."

Professor Vincent du Vigneaud, of the School of Medicine of the George Washington University, addressed a joint meeting of the Toronto Chemical Association and the Toronto Biochemical Society on January 16. His subject was "Some Investigations on Homocystine and Related Sulfur Compounds."

Dr. E. R. Weidlein, director of the Mellon Institute, Pittsburgh, who was recently elected president of the American Chemical Society, gave an address before the Lancaster Branch of the American Association for the Advancement of Science on February 4. The title of the lecture was "Glances at Scientific Research."

Dr. W. F. Loehwing, professor of botany at the State University of Iowa, addressed the Society of Sigma Xi at Iowa State College on two plant hormones on January 23.

DR. ELLIOT POWERS, of the department of geology and geological engineering of the Gulf Production Company, gave the address before a joint meeting of the Sigma Xi Club and the Faculty Science Club of Texas Technological College on January 15.

DR. LACHLAN GILCHRIST, retiring president of the Royal Astronomical Society of Canada and professor of geophysics in the University of Toronto, delivered the presidential address on "Cosmic Radiations and Astronomical Research" at the society's annual at-home held at the University of Toronto on February 4.

IN compliance with the requirements of a gift under the will of the late Francis Amory, of Beverly, Massachusetts, the American Academy of Arts and Sciences announces the offer of a septennial prize for outstanding work with reference to the alleviation or cure of diseases affecting the human genital organs, to be known as the Francis Amory Septennial Prize. In case there is work of a quality to warrant it, the first award will be made in 1940. The total amount of the award will exceed ten thousand dollars, and may be given in one or more awards. While there will be no formal nominations, and no formal essays or treatises will be required, the committee invites suggestions, which should be made to the Amory Fund Committee, care of the American Academy of Arts and Sciences, 28 Newbury Street, Boston, Massachusetts.

THE late Professor Ramón y Cajal has left a legacy of 25,000 pesetas to found a prize to be awarded by the Spanish Academy of Medicine for the best work on a subject to be settled by that body.

A SET of books, many of them rare, which contain virtually all the scientific data available regarding Spitzbergen, were given recently to the library of the Michigan College of Mining and Technology, Houghton, by the estate of John M. Longyear, the engineer, who died in 1922. Mr. Longyear gathered the set while investigating the coal resources and productivity of the island. Among the oldest volumes are those narrating the visits of seventeenth-century Dutch explorers to Spitzbergen.

Nature states that on the occasion of the seventy-fifth anniversary of its foundation, the Dr. C. Schleussner Company of Frankfort-on-Main offers a prize of 2,000 gold marks for the best scientific work on röntgenology. The president of the German Röntgen Society, in conjunction with the Dr. C. Schleussner Company, will decide the award. Purely technical and statistical works as well as those already published are excluded from the competition.

ACCORDING to the *Journal* of the American Medical Association, Dr. Arthur W. Rogers, for many years director and owner of the controlling interest in the Oconomowoc Health Resort, a sanatorium for nervous and mental disease near Oconomowoc, Wis., has purchased all stock of the institution, converting it into a non-stock, non-profit-making corporation as a memorial to Mrs. Rogers. It will henceforth be known as the Rogers Memorial Sanitarium, operated by Dr. Rogers under the direction of a board of trustees. In addition, Dr. Rogers has arranged that his entire estate will be left as an endowment for the institution. Income from this fund will enable the sanatorium to establish a psychiatric laboratory, to hold clinics and graduate courses in neurology and psychiatry, to publish papers and in general to conduct a sanatorium at minimum cost to its patients and to contribute to the advancement of neurology and psychiatry. The sanatorium is made up of a main building with adjacent cottages on a fifty acre estate on Upper Nashotah Lake in Waukesha County. It is estimated that Dr. Rogers' gift is worth about $1,000,000.

A FEDERAL grant of $1,220,000 (30 per cent. to be given outright, 70 per cent. as a loan) for building the second unit of the Medical and Dental College Laboratories Building of the University of Illinois in Chicago has been approved at Washington and the Board of Trustees has received bids for the work. The low bids exceed the amount of the present loan and grant, and alternative proposals are under consideration by the Board of Trustees and the Federal Emergency Administration of Public Works in the hope that this project can still go forward. Funds for the new unit were originally appropriated by the state legislature in 1931, but the university at that time voluntarily turned back the money because of the state's acute financial condition. This year the university was authorized to borrow money from the federal government for the completion of the plans and at the same time providing means for repaying the loan to the government. It was the hope of the board to have the new units ready for occupancy by the fall of 1936, thus enabling the College of Dentistry to abandon its old quarters, called by a special legislative committee in 1931 "a fire trap and a disgrace to the State." Finally, this new unit will bring nearly all the professional departments under the same roof, thus increasing the continuity of the work.

HUNTINGTON COLLEGE, Huntington, Indiana, has set aside five of its sixty acres of gently rolling and partially wooded campus for an Arboretum and Botanical Garden and has placed it under the direction of Fred A. Loew, head of the department of biology. It is planned to bring into this garden as many trees, shrubs and herbaceous plants native in the state of Indiana as can be grown in this environ-

ment. One plat will be devoted to experimental work in plant genetics under the direction of Professor R. W. Wood.

Realization of the rapidity with which the last remaining stands of virgin deciduous forest in Kentucky are being cut down has led to the organization of a league whose objective is the acquisition of the last remaining forests to be maintained as inviolate preserves. The "Save-Kentucky's-Primeval-Forest" League hopes to do for the deciduous forest what the "Save-the-Redwoods" League has done for California's redwood groves. The organization meeting was held in Lexington at the call of Miss Daisy Hume, a representative on the National Conservation Committee of the Garden Club of America. A further meeting was held in Lexington on January 4. Mrs. Bailey P. Wootton, of Frankfort, is secretary-treasurer of the league.

A correspondent of the *Journal* of the American Medical Association reports that a new Microbiologic Research Institute has been established in connection with Osaka Imperial University for which it is planned to erect a large building. There has been only one institute in Japan of this kind, the Infectious Disease Research Institute in Tokyo, which is chiefly devoted to studies of microbiology and to the manufacturing of preventive vaccines. Osaka is often called the gateway of infectious diseases from abroad, and so it will be more convenient for this kind of work than Tokyo. The new institute will study chiefly leprosy, tuberculosis, bacteriology and the prevention of epidemics. It will deal with infectious diseases that are closely connected with the surgical, internal and dermatologic departments. The first chief is Professor Dr. Yashiro Furutake, of the medical department of the university. Drs. Taniguchi, Satani, Imamura, Hosokawa and Sakurai, who are professors and assistant professors of the university, are on the staff. It will be completed in 1939 and the annual expenditure is expected to amount to over 330,000 yen.

The American Medical Association plans to modernize its building in Chicago at a cost of $400,000. It is announced that approximately $200,000 will be spent on the two-story top addition. The balance will be used for modernizing the entire building and making many changes in departments. The entire new top floor will be used for enlarged editorial and library space. The executive, secretarial and business offices will be moved to the new seventh floor. Various special bureaus will occupy the present sixth floor. The printing departments and others will use the remaining lower stories. Founded in 1847 the American Medical Association now has a membership of 100,000 out of the 130,000 practicing physicians in the United States. It publishes many medical magazines and booklets on its own presses. It employs 550 men and women on a day and night shift. Dr. Olin West is secretary and manager. Dr. Austin A. Hayden is secretary of the board of trustees.

DISCUSSION

COMPUTING PROGRESS IN CHEMISTRY

Men attempting to measure the progress of science and the progress of civilization have failed to find an acceptable yardstick on which they may mark those numbers which are needed to satisfy their scientific minds, and, moreover, they have not been able to compute the numbers to give a scientific answer to the question in their minds.

The American Chemical Society, without knowing what it was doing, has built the yardstick and computed the numbers for marking the yardstick of progress by publishing its twice-a-month journal, *Chemical Abstracts.*

The American Chemical Society, faced by the unwieldy chaotic mass of rapidly accumulating chemical facts and chemical theories, early this century selected editors and set them to work devising a plan for bringing order out of the chaos, asking them to seek a key to the constantly growing mass of chemical literature throughout the world.

These editors began the magazine *Chemical Abstracts* in January, 1907, endeavoring to collect, condense and then publish in it an abstract of every worthwhile article on chemicals or chemistry appearing in the current scientific magazines.

The first year they condensed and published 7,975 such abstracts, the next year 10,835, and so on, increasing an average of about two thousand a year, until they published 19,025 in 1913.

The great war set back the number until they published only 9,283 in 1918, but immediately after the war the old pace of increase at about two thousand a year reasserted itself. In 1923 they published 19,507 abstracts, which brought them back to where they were in 1913, and the annual increase of two thousand a year marched on to the end of 1935 unaffected by the economic depression so that it is estimated that they published 42,468 abstracts in this last year.

The slight variations of the "curve" shown in the accompanying chart are explained by the editors.

For example, the drop in the curve for the year 1931 was caused by many abstracts due for publication in 1929 which were held over to 1930 for budgetary reasons, thus heaping up additional abstracts in 1930. Others due for publication in 1931 were held over (about 2,500 of them) until 1932, thus also explaining the apparent drop in 1933.

The inquisitive mind that looks at this yardstick of *Chemical Abstracts,* covering five war years, seven pre-war years and seventeen post-war years, says to itself, "How far have we a right to look into the future through these years as a telescope?"

In answer to such question a well-informed scientist will say: "Those seven peace years plus seventeen peace years are twenty-four peace years, of almost uniform progress. It is fairly safe to count on the same progress continuing twice as much longer, say to the year 1985."

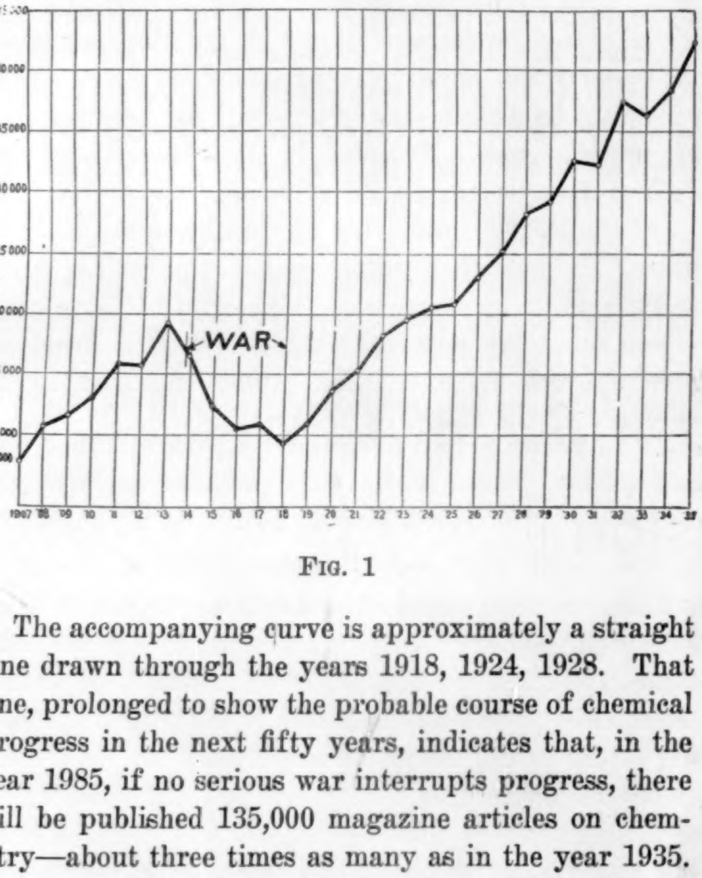

Fig. 1

The accompanying curve is approximately a straight line drawn through the years 1918, 1924, 1928. That line, prolonged to show the probable course of chemical progress in the next fifty years, indicates that, in the year 1985, if no serious war interrupts progress, there will be published 135,000 magazine articles on chemistry—about three times as many as in the year 1935. In other words, chemical knowledge and the library of chemical facts will be growing three times as fast in 1985 as in 1935.

The curve in the chart misleads a person who looks into the past instead of into the future, for its slope backward from 1913 to 1907 seems to indicate that chemical progress first came to life a few years before 1907, perhaps about 1901.

Other abstract chemical journals are found on the shelves of many libraries, going back to 1880 in England, and still further back in Germany, and stand on those shelves as monuments to prove that chemists and chemistry were very much alive long before 1901.

The truth seems to be that chemistry was marching steadily along the road of progress for a hundred years before 1901 with chemists publishing a few score or a few hundred magazine articles on chemicals each year, increasing the number very slowly until about the year 1900, when the newly discovered argon, helium on the earth, neon, radium and x-rays began to revolutionize chemistry.

The editors of those British and German abstract chemical journals made no serious attempt to cover the wide field covered by the editors of *Chemical Abstracts,* so no safe estimates can be based on those abstract journals. All that can be said is that they prove chemistry was alive and growing before 1907, but growing for the most part much more slowly than in recent years. The library of chemical facts increased very slowly in the days of forty or more years ago.

To this should be added an estimate that progress has been growing at a faster rate than the curve indicates, because to-day, more than in the past, a magazine article on new chemicals is likely to describe several or even many new chemicals. Modern chemists make one new chemical, and from it make numerous derivatives to complete an investigation planned along lines utterly unknown to chemists of the past.

It hardly seems possible that the progress in chemistry in all the century before the year 1900 could have produced much more than the 42,468 abstracts published in 1935. In other words, the march of chemical progress each year carries the world almost as far forward as did the march of progress in the whole century between 1800 and 1899.

This forward march each year seems to be in the neighborhood of one per cent. per year of all prior progress added together—or only a fraction of the growth of wealth as estimated by economists. It has been reported that the economists consulted as advisers, when asked by the makers of the Treaty of Versailles what Germany could pay, said, "In normal times national wealth in a civilized nation grows between three per cent. and five per cent. each year."

How about mechanical progress? Can we produce a similar or a different curve for mechanical progress? To this it is possible to answer: "This curve represents the speed of chemical progress. No similar data have been found for drawing a separate curve of mechanical progress, but data have been found which indicate that the curve for mechanical progress must follow closely along the curve of chemical progress."

One record of mechanical and chemical progress is the patents issued by the United States Patent Office and by other patent offices. This record of patents issued is very defective as an index of progress, for several reasons. First, each patent issued represents

an invention a year old or several years old. Second, the issue of patents drops greatly during and following an economic depression, such as that following the year 1929. Third, changing policies in the Patent Office produce unmeasurable changes in the number of patents allowed to issue.

In a normal year about one patent issues for every two patent applications filed, but in the year 1935, about one patent issued for every one and one-third patent application filed, most patents being based on patent applications two, three or more years old.

On the other hand, the number of patents issued varied little during the ten years from 1870 to 1880, although those years saw the invention of the electric motor, the telephone, the incandescent electric lamp and other important inventions shown in the Centennial Exhibition of 1876.

The number of patents issued each year by some other nations varies much more widely and more rapidly than in the United States. England, for example, issued about 12,000 patents in 1931, about 24,000 in 1930 and about 35,000 in 1933. It is obvious that the number of patents issued is an unsafe guide by which to measure progress.

The proportion of chemical patents issued each week in the United States has, in contrast, remained singularly constant for thirty years at about one in every fourteen of all patents issued. In other words, the curve of progress in mechanics must be nearly identical with the progress in chemistry if statistics of issued patents mean anything.

One further observation must be made pointing to the years 1914 to 1918, and that is to point the lesson of the cost of war. The asserted stimulus to chemistry due to war does not appear either in those years or in any showing of heaped-up and buried progress released to show itself at the end of the war. On the contrary, each year of war apparently set back progress more than the progress gained in a year of peace, and each year of war apparently added its set-back to the set-back of the previous year of war. It is evident that the much-boasted chemical progress whipped-up to meet war needs is trivial compared to the work-a-day progress in times of peace.

Edward Thomas

Woolworth Building
New York, N. Y.

POLYGONBODEN ON MT. DESERT ISLAND, MAINE

Antevs[1] has described both fossil and modern stone nets and stone stripes from the Presidential Range, New Hampshire, and from Mt. Katahdin, Maine, at elevations of 4,000 feet and higher. The authors have found modern stone nets and stone stripes on Cadillac Mountain and on Jordan Mountain, and Professor Edward H. Perkins, of Colby College, has found them on Sargent Mountain, Mount Desert Island, Maine. On Cadillac Mountain they were observed as low as 1,300 feet and on Jordan Mountain as low as 1,100 feet, which makes these the lowest described Polygonboden in the United States. The nets and stripes on Jordan Mountain are embryonic and vague but rather numerous. Those on Cadillac Mountain are in many cases well formed, as well formed as any the authors have seen on Mount Washington, besides being much more numerous. These structures are found in the small barren patches of more or less modified glacial till, sometimes admixed with disintegrated granite, which is still preserved in places. The average diameter of the nets is one to two feet and the stripes are from four to five feet long. These are undoubtedly being formed at the present time and are similar to the modern stone nets and stone stripes which Antevs has described. These structures are undoubtedly present on other peaks of Mt. Desert Island, and it is the intention of the authors to return and go over the ground more thoroughly with the hope of finding these features at lower levels, perhaps even at sea-level.

It is generally agreed that the conditions necessary for the formation of these structures are: (1) freezing temperatures; (2) correct soil conditions; (3) flat areas with slight slope and (4) barren areas. It may well be that the first three of these conditions obtain at sea-level in the Mount Desert area. However, barren areas are not common unless made by man. An examination of old sand and gravel pits might furnish some interesting data, and along this line it would be interesting to prepare some earth at sea-level to see if the Polygonboden would form. The authors spaded up one area which contained especially well-developed structures with the idea of returning to collect data on their rate of formation. The material in which the Polygonboden are formed often rests in rock basins, which condition makes for a high water table. This condition, together with the high precipitation on the Mount Desert mountains and the great number of barren areas, is probably responsible for the low elevation of the Mount Desert Polygonboden.

Robert L. Nichols
Frances Nichols

Tufts College

[1] Ernst Antevs, "Alpine Zone of Mt. Washington Range," Merrill and Webber Company, Auburn, Me., 1932.

"PETRIFIED WALNUTS" VS. CONCRETIONS

Several years ago Mrs. George W. Rust, who was then Miss Alce Ann Clark, student of the University

of Chicago, was shown some "petrified walnuts" by a resident in the vicinity of Dayton, Wyoming. Mrs. Rust brought some of them back to Chicago with her and gave them to Professor F. J. Pettijohn, who examined them and commented on their unusual characteristics.

Quite ignorant of the fact that such concretions had been previously seen by Profesor Pettijohn, the writer described[1] some concretions (apparently of the same sort) which were given to him by Mrs. F. C. Sayles, Jr., Ishawooa, Wyoming. Their external surface and size is remarkably similar to that of a black walnut. When broken open, they show an irregular chamber containing dark-colored oxides (the nutmeat?), which is encased in a plumose structure made up of radiating crystals of dahllite. This mineral is comparatively little known, although it is not rare in phosphorites.

Concretions of similar structure and mineralogical composition occur in Podolia, U. S. S. R., and these are described by O. Stutzer[2] as being as large as a "Kegelkugel" (bowling ball).

Duncan McConnell

FLUCTUATIONS IN NUMBERS OF VARYING HARES

Since the autumn of 1931 an investigation of the recurrent rise and fall in numbers of snowshoe rabbits or varying hares (*Lepus americanus*) in Ontario particularly has been in progress under the joint auspices of the department of biology of the University of Toronto and the Royal Ontario Museum of Zoology.

No hares sick with tularemia have been found, but of twenty-four samples of blood serum tested previous to 1935 three gave a positive agglutination reaction, indicating that these animals had recovered from the disease.

A chronic infection with *Staphylococcus aureus* is common and correlated with the fact that snowshoe rabbits have practically no Staphylococcus antitoxin in their blood. One fatal case of empyemia with pus all through the lungs and heart has turned up. The pus masses of the more common cases, on the head, legs or chest, certainly reduce the beasts' margin of safety under adverse conditions. Several other diseases are being studied.

That part chiefly of the normal intestinal flora of varying hares which is composed of bacteria of the family *Bacteriaceae* Cohn has been surveyed.

The most serious helminth parasite has been a strongylid stomach worm, probably Obeliscoides. A moderate number of these blood-sucking worms have been found in the stomachs of nearly all the hares autopsied from all parts of the province and may be considered "normal." However, it does appear to have caused the deaths of six out of seven recently captured and well-cared-for hares that died "natural deaths" at Smoky Falls on the Mattagami River in northern Ontario in the summer of 1935.

In general, the last winters of great abundance of hares in various sections of the province were as follows: northern part of Frontenac County, 1931–32; southern Ontario, 1932–33; central Ontario north to about the height of land, 1933–34; northern Ontario, 1934–35 (questionnaires this coming winter will corroborate or modify this last statement); and the region west of Lake Nipigon averages intermediate between northern and central Ontario. This is in accordance with the northward trend of isotherms and life zones to the west.

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MILK AS A SOURCE OF VITAMIN C[1]

Estimates of the amount of vitamin C in milk have varied widely. More recent studies have placed the amount of fresh raw milk needed to protect a guinea pig from scurvy at approximately 40 cc per day. The amount of purified vitamin C needed for protection of this species has ranged from 0.7 to 1.3 mg daily. If the average of 1.0 mg per day is accepted, milk should contain about 25 mg of vitamin C per liter on a comparable basis.

The authors have had an opportunity to make chemical tests of the vitamin C content of milk on an extensive scale. A total of 502 determinations have been made to date on the milk of 55 cows representing the four major dairy breeds—Holstein, Jersey, Guernsey and Ayrshire. An average value of 25.9 ± 4.3 milligrams per liter was secured.

While no conclusive data pertaining to the human requirement for vitamin C are available, a range of 19 to 27 mg daily has been suggested as the minimum protective requirement.[2] Fresh milk, therefore, may be an important source of vitamin C. It has been found recently at this station that much of this vitamin C content can, with proper precautions, be conserved satisfactorily either in raw milk or in milk that has been pasteurized by the flash method.

C. H. Whitnah
W. H. Riddell

Kansas Agricultural Experiment Station

[1] *Amer. Mineral.*, 20: 693–698, 1935.

[2] Die Wichtigsten Lagerstätten der Nicht-Erze, Vol. I, p. 341, 1911.

[1] Contribution No. 200, Department of Chemistry and No. 105, Department of Dairy Husbandry.

[2] G. F. Gothlin, *Nature*, 134: 569, 1934.

REPORTS

UNIVERSITY OF MICHIGAN GEOLOGICAL EXPEDITIONS TO MEXICO

FOR the past six years the University of Michigan has sponsored a program of cooperative geological investigations in northern Mexico. The purpose of the project is to pursue studies on the interrelation of paleogeography, structure, igneous activity and ore deposition in northern Mexico along the southern margin of the North American continent as it existed during most of the Mesozoic era. Geologists from the faculties of seven American universities and colleges have taken part, including Chicago, Johns Hopkins, Michigan, Michigan State, Rochester, Rutgers and Texas Technological College. The project has been supported by the National Research Council, the Geological Society of America and the University of Michigan. With the completion of reports resulting from last season's field studies the project will be concluded. Twenty papers have been prepared on the results of these cooperative studies. They are being published by the Geological Society of America and the University of Michigan. The following geologists have been on one or more of the expeditions and have prepared reports dealing with various phases of the project: E. S. Bastin, R. W. Imlay, T. S. Jones, L. B. Kellum (director), W. A. Kelly, W. I. Robinson, Q. D. Singewald and E. H. Watson. Some of the principles of continental development established and regional conclusions reached as a result of the cooperative project are summarized below.

I. The margin of the Coahuila Peninsula of Jurassic and Neocomian time has determined the strike of the folding which took place in post-Neocomian sediments, giving rise to a prominent zone of cross-folding which extends east-west across the Rocky Mountain Cordillera for a known distance of 200 miles.

II. The peninsula, which was gradually submerged in post-Neocomian time, controlled the type of structures which developed during the Tertiary in the overlying sediments. There is a marked contrast between the relatively simple, open folding of Lower Cretaceous rocks above the early Mesozoic peninsula and the tight, asymmetrical folding and overthrusting in the area of the geosyncline to the east, west and south of the peninsula.

III. Slow submergence of the Coahuila Peninsula during the latter part of the Lower Cretaceous caused the formation of lagoons to become wide-spread over the flats of the subsiding land. Thick gypsum deposits in the Cuchillo formation were deposited in these lagoons, and the distribution of the gypsum facies is therefore limited approximately to the area earlier occupied by the peninsula.

IV. Thick wedges of clastic sediments occur adjacent to the continental margin of Neocomian time and become rapidly thinner offshore; limestone wedges appear in the section and become thicker seaward from the ancient continental margin.

V. Five periods of igneous activity have been recognized in the marginal zone of the Coahuila Peninsula. The magmas were alternately intrusive and extrusive. Observations made up to the present time indicate that in the two earlier periods (Permian and Pre-Cretaceous) the igneous phenomena developed in the area of the Coahuila Peninsula; while in the three later periods (Tertiary) the igneous activity was entirely outside the margins of the peninsula and within the geosyncline.

VI. Three periods of major diastrophism are recognized in northern Mexico. The first is correlated with the Appalachian revolution and can be seen in the basement rocks of the Coahuila Peninsula; the second is correlated with the Laramide revolution and can be seen in the intensely folded Cretaceous rocks on most of the highland plateau of Mexico; the third was a period of contraction in the earth's crust that gave rise to normal faulting in the mid-Tertiary and probably continued into Quaternary time.

VII. It has been demonstrated that Laramide orogeny in northern Mexico began in early or mid Upper Cretaceous time with the broad warping and slow uplift of certain large blocks of the continent. One of these positive blocks lay north and another south of the Parras Basin, while this basin occupied a negative block which subsided many thousands of feet during the Upper Cretaceous. At the close of the Upper Cretaceous (Maestrichtian) the sea withdrew entirely from the Parras Basin trough and the entire Cordilleran province was elevated above sea level. Intense folding then took place during the Eocene. The geosyncline of pre-Aptian time was plicated into sharp anticlines and synclines, local isoclines, fan-folds and overthrust faults.

VIII. Continuous marine deposition during late Lower and early Upper Cretaceous occurred over an extensive area in northern Mexico, forming the Indidura formation. This formation has now been recognized in many scattered localities. Its large fauna has been described and figured and the faunal zones determined.

IX. The recognition and clear delineation of many facies of deposition and their interpretation in terms of paleogeographic development have cleared up many heretofore doubtful relations in the stratigraphy of Mexico. These studies, based on marine invertebrate faunas as well as on well-defined lithologic units, remove the controversies from the realm of speculation.

X. Data obtained from scattered outcrops of the

basement rocks comprising the Coahuila Peninsula have been brought together; their lithology and structure have been summarized; the size and position of the peninsula have been revised; the probable source of much of the coarse agglomeratic material in the neritic facies of the Neocomian and Upper Jurassic of northern Mexico has been found in the basement rocks of the Coahuila Peninsula.

XI. The similarity of certain faunal elements in the Upper Jurassic and Neocomian sediments of California and Northern Mexico suggests that seas which occupied these geosynclines were at times connected across northern Mexico. The scattered faunal evidence bearing on this paleographic problem has been assembled.

LEWIS B. KELLUM

UNIVERSITY OF MICHIGAN

SPECIAL ARTICLES

THE BIOLOGIC EFFECTS OF PINEAL EXTRACT (HANSON)[1]

IN a previous communication on September 21, 1934, attention was called to the biological effects of thymus extract (Hanson) on accruing acceleration in growth and development in each successive generation of young born to succeeding generations of parents under treatment. At that time it was stated that similar studies had been undertaken with other hormones and glandular products. The results to date with pineal extract (Hanson) are, in our opinion, of such interest as to warrant publication.

The extract employed most frequently (PB_{22}) was one of several prepared by Hanson. It represents an aqueous acid derivative, probably in the form of a picrate, and containing 0.21 per cent. free picric acid. It is relatively non-toxic but somewhat irritating locally. One can not, however, escape the impression that it is somewhat of a deterrent to the general good health of the rats in the experiments herein described. To date more refined extracts seem to lack the activity apparent in PB_{22}. Further studies in this field are in progress.

To date five successive generations of the pineal strain of rats have been under observation. An analysis of the biological data of each of these generations reveals significant facts. In the first generation no effect is apparent other than moderate loss of weight and phenomena suggestive of sex excitation and early breeding. In the second generation there is definite retardation in growth, with mild precocity in gonadal development. In subsequent generations, the third to the fifth, there is accruing retardation in growth with accruing acceleration in gonadal and bodily development. Precocious "dwarfism" with relative macrogenitalism are the outstanding result. In addition eye anomalies, ocular diseases and blindness are extremely common.

[1] From the Philadelphia Institute for Medical Research, from the Samuel Bell, Jr., Laboratory in the Philadelphia General Hospital, the Laboratories of the Philadelphia General Hospital, Philadelphia, Pennsylvania, and the Hanson Research Laboratory, Faribault, Minnesota. We wish to acknowledge with gratitude the financial assistance given one of us, Dr. Hanson, by the Josiah Macy, Jr., Foundation.

The effects of pineal extract on growth is revealed in Fig. 1, which represents the growth curve of the

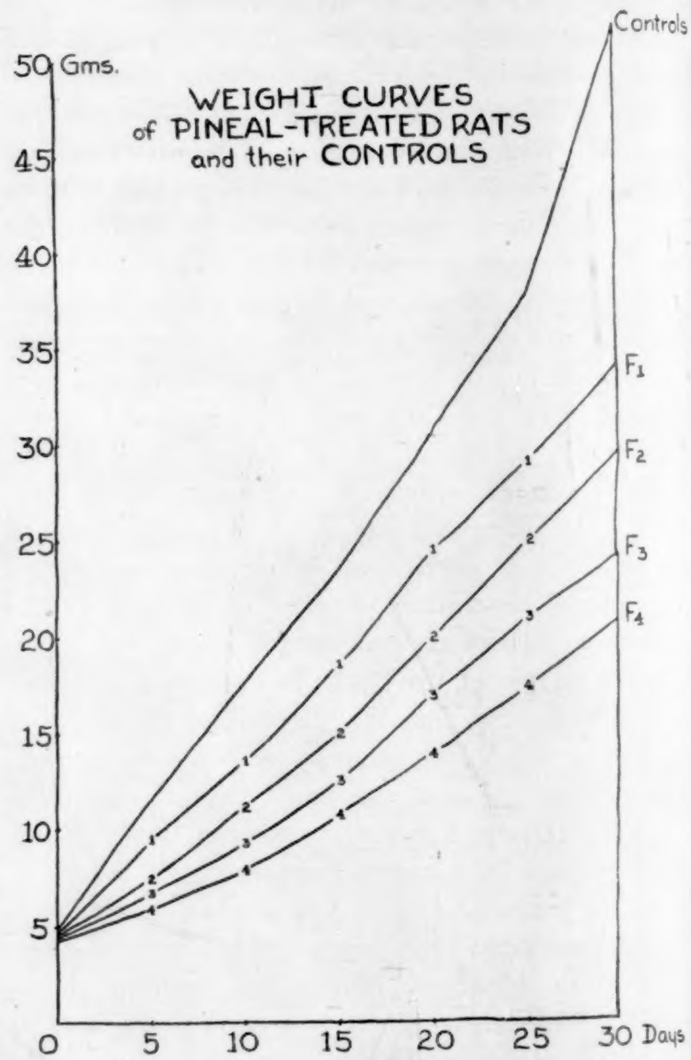

FIG. 1

young of five successive generations of rats treated with pineal extract. The "dwarfism" resulting from pineal extract (Hanson) is usually permanent, though less striking as the animals age. In rats of the second or later generations, perhaps less than 10 per cent. attained normal weight or growth. The early employment of potent extract in the young almost always insures more striking and more permanent "dwarfism."

Though small in size, the resulting animals are precocious in development. The acceleration in differentiation is shown in Table 1. Lack of uniformity in

PROGRESSIVE DEVELOPMENT UNDER PINEAL TREATMENT

	Ears Opd.	Teeth Erupt.	Fur Appd.	Eyes Opd.	Testes Descd.	Vagina Opd.
Controls	2½–3½	8–10	16	14–17	31–40	55–72
	(3)	(9.0)	16	(15.5)	38	65
F_1	2–3	8–10	7–16	12–17	12–36	32–56
	(3.3)	(9.0)	(13.0)	(14.9)	(22.0)	(45.0)
F_2	2–3	7–11	6–17	12–16	6–26	30–39
	(2.8)	(9.0)	(12.0)	(13.8)	(15.0)	(37.0)
F_3	2–3	5–8	5–12	5–13	5–12	29–39
	(2.3)	(6.9)	(9.0)	(9.8)	(10.0)	(32.0)
F_4	1–3	3–5	4–8	4.8	4–9	23–26
	(2.0)	(4.0)	(5.0)	(6.0)	(5.0)	(24.0)

The number of rats constituting the basis for the weight curves is as follows: For the controls, 301 rats, for the F_1 Generation, 138 rats, for the F_2 Generation 543 rats, for the F_3 Generation 155 rats and for the F_4 Generation 41 rats.

size and in the rate of growth and development of individual members of a litter is striking. Because of this variability, the range of values, as well as the average, is presented in the accompanying table.

The compiled data on both the growth and development, as expressed in tables and curves, reveal the same step-like progression in succeeding generations under treatment as was evidenced in our thymus-treated strain of rats. However, in the pineal studies there appears a paradox, a dissociation of the effects on growth and differentiation. The progressive accruing effect is in two or possibly three directions, retardation in growth accompanied by acceleration in gonadal development and also in bodily differentiation.

Caution must be exercised in interpreting these biological effects as indicating the functions of the pineal gland. If such were the case, then one should expect pinealectomy to result in enhanced growth and retarded development. Such, however, is not the case to date in the majority of instances in a small series of rats subjected to pinealectomy in our institute by Dr. N. H. Einhorn. Further studies in this connection are desirable.

From the foregoing it is evident that our results in the study of many hundreds of rats do not conform entirely to any of those reported in the literature. It is true that in common with the majority of workers we have observed little of significance in the first generation under treatment. In the subsequent generations we have found consistently "dwarfism," rather than overgrowth. Precocity, however, has been observed in all our animals from the third generation on and this concerns both gonadal and bodily development. The resulting animal is small, usually half or less than half the normal size, during the early weeks of life, precocious in development, with gonads suggesting the macrogenitalism seen clinically in certain types of tumor of the pineal gland. In addition the animals are physically weak and appear more irritable and nervous than normal, and eye anomalies abound.

CONCLUSIONS

Pineal extract (Hanson) has retarded the rate of growth and accelerated the rate of differentiation and has hastened the onset of adolescence in the offspring of treated parents. The end result is "dwarfism" with precocious development and relative macrogenitalism.

The injection of succeeding generations of parent rats has resulted in the amplification of these biologic effects in succeeding generations of their young.

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ARTIFICIAL CONTROL OF NUCELLAR EMBRYONY IN CITRUS

THE supernumerary embryos, other than those of seminal origin, which develop from seeds of most species of citrus and related genera were identified as cases of nucellar embryony by Strasburger,[1] a form of sporophytic budding.[2] It has been repeatedly noted that the number of embryos developed from individual seeds may vary from one to many in any particular lot of seeds.[3] This would indicate that, although the tendency to produce nucellar embryos is inherited, the environment may materially influence the number of such embryos actually developed under any particular set of conditions. This tendency to produce supernumerary nucellar embryos is a serious handicap to any effective study of progeny in citrus-breeding experiments. The observation with reference to the variability in the number produced, however, pointed to a possible method of solving the problem. A working hypothesis was formulated on this basis and definite experiments initiated to test it.

The original hypothesis, formulated in 1932, was that the initiation of such nucellar embryos might be inhibited or that such embryos might be rendered inactive or destroyed after formation by decreasing the food supply ("starving" the entire pericarp). Since 1932 the hypothesis has been amplified as to the nature of the environmental factors which may be operative—the nature and amount of food supply, moisture supply, temperature, age of seed, seed maturity, desiccation of seed, etc.

The specific method used in the initial attempts to decrease the food supply available to the developing pericarp was to keep it and the surrounding leaves covered until maturity with three thicknesses of cheese-

[1] E. Strasburger, *Zeitschr. f. Naturwiss*, 12: 654–678, 1878.

[2] L. W. Sharp, "An Introduction to Cytology," 2nd Ed., 1926.

[3] H. J. Webber, *Hilgardia*, 7: 1–79, 1932; *Calif. Agr. Expt. Sta. Bul.*, 317, 1920; *Jour. Hered.*, 11: 291–299, 1920. Howard B. Frost, *Hilgardia*, 1: 365–402, 1926. H. J. Toxopeus, *Landbouw (Buitenzorg) Jrg.*, 64: 1930–31.

cloth, and in addition to reduce the leaf area on the twig bearing the fruit. Such fruits when harvested were pale yellow and weighed only about one third as much as untreated fruits. The seeds were germinated during the winter 1933–34 in flats in the lath-greenhouse. The number of seeds producing more than one embryo was from 51 per cent. to 100 per cent. below expectancy: *Sweet orange,* Lamb ♀ × Valencia ♂, 51 per cent.; Lamb ♀ ♂, 51 per cent.; Hamlin ♀ × Temple ♂ 75 per cent.; Hamlin ♀ × Ruby ♂, 85 per cent.; Temple ♀ ♂ 100 per cent.; *Sour orange,* Bittersweet ♀ ♂ 95 per cent.; *Grapefruit,* Triumph ♀ ♂ 66 per cent.

The progeny from treated ("starved") self-pollinated grapefruit and sour orange fruits segregated for leaf characters. In the first case distinctly sweet orange and grapefruit types, as well as intermediates, are in evidence; and in the second case sour orange, intermediates and sweet orange types are observable. These two varieties are commonly considered as naturally occurring hybrids with the sweet orange, and this segregation of leaf characters tends to confirm this belief, and also indicates that the progeny is in most cases apparently of seminal origin.

Additional work is being done on an extensive scale, but this will require experiments covering several years. It is especially desirable to carry through the progeny to the fruiting stage. Histological study of treated and untreated material also will be of importance in attempts to check the results. These preliminary results, which may or may not be firmly established by experiments now in progress, are published now as a suggestion of possible value to others faced with the same problem in citrus breeding.

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THE ERGOT ALKALOIDS. THE ULTRAVIOLET ABSORPTION SPECTRA OF LYSERGIC ACID AND RELATED SUBSTANCES

THE fact that the four ergot alkaloids—ergotinine, ergotoxine, ergotamine and ergotaminine—give almost identical ultraviolet absorption spectra has already been determined by Harmsma,[1] who devised a spectrophotometric method for the determination of these substances. In connection with our own investigations of the structures of the ergot alkaloids, we have had occasion to study the ultraviolet absorption spectra of lysergic acid and several of its derivatives. The resulting curves are shown in the accompanying plate. On inspection, it will be noted that both dihydrolysergic acid and the alcohol, α-dihydrolysergol, give similar curves, whereas, in the case of lysergic acid, the bands and maxima are considerably displaced. The curve for α, β-dimethyl indole was also found to be very close to those of the above dihydro derivatives. Finally, the carboline derivative, 3, 4, 5, 6-tetrahydro-3-methyl-4-methyl-4-carboline-5-carbonic acid, obtained by the condensation of abrine with acetaldehyde gave a curve also closely approaching these. It is therefore apparent that the structure which all these substances have in common and which appears mainly to be responsible for the observed effects is the indole nucleus. In the case of lysergic acid, the displacement of the bands is apparently due to the double bond which is removed on hydrogenation to the dihydro derivatives. The strong influence noted indicates conjugation of this double bond with one of those contained in the indole nucleus.[2] There is a close resemblance between the lysergic acid curve and those derived from the ergot alkaloids by Harmsma.[3]

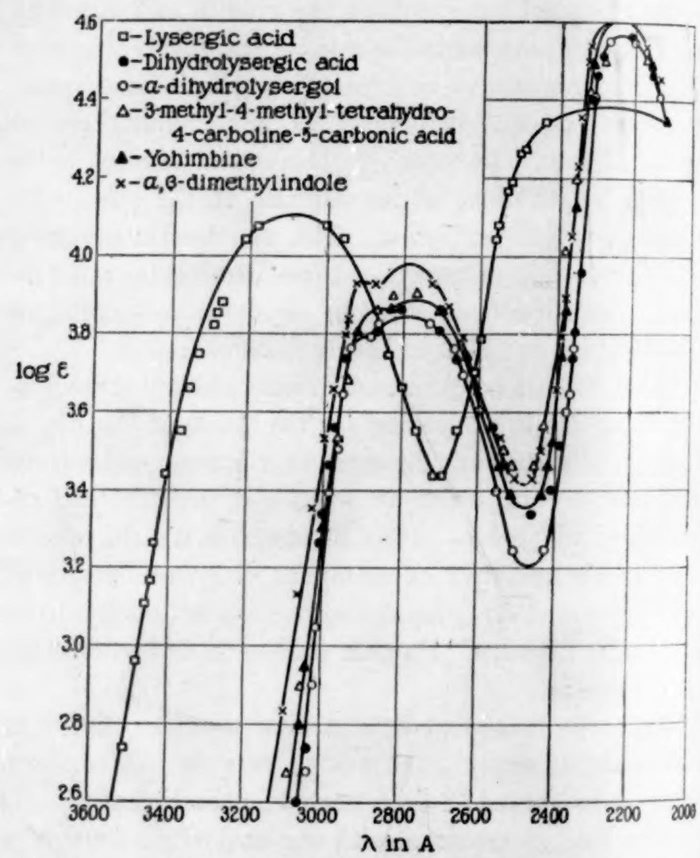

FIG. 1. ε is the molecular extinction coefficient. Alcohol with a slight excess of ammonia was the solvent used.

Recently Kharasch, Stanger, Bloodgood and Legault[4] have attempted an interpretation of the structure of lysergic acid from similar absorption spectra studies made with ergotocin and its derivative. Be-

[1] A. Harmsma, *Pharm. Weekbl.*, 65: 1114, 1928.

[2] Ramart-Lucas and P. Amagat, *Bull. Soc. chim.* (4) 51: 965, 1932. A. Hillmer and P. Schorning, *Z. physik. Chem.*, Abt. A, 167: 407, 1933; 168: 81, 1934.

[3] A similar curve was observed with ergotinine by V. Brustier, *Bull. Soc. chim. d. France* (IV) 39: 1538, 1926.

[4] M. S. Kharasch, D. W. Stanger, M. D. Bloodgood, and R. R. Legault, SCIENCE, 83: 36, 1936.

cause of the close resemblance of the curves obtained with hydrogenated ergotocin and yohimbine (our own recent determination with the latter is given in the above curve), they have drawn conclusions regarding the closely related skeletal structures of the two alkaloids. However, as we have shown above, in so far as the absorption curves of hydrogenated lysergic acid and yohimbine are concerned, such conclusions must relate only to the indole nucleus common to both. In their rejection of a structural relationship between ergotocin and the harmala (carboline) alkaloids because of the different absorption spectra obtained with harmol, harmine and harmaline, they did not consider the modifying influences of the double bonds present in the third carboline (pyridine) ring and which are conjugated with the indole ring system in these particular alkaloids. As we have shown above, in the case of the tetrahydrocarboline derivative, where such an influence has been removed, the curve is very close to that of dihydrolysergic acid. Furthermore, conclusions regarding the structure of lysergic acid which are based on an interpretation of data obtained with "ergotocin" we must regard as unconvincing until more complete data are furnished us regarding the hydrolytic products of this particular substance, for which the formula $C_{21}H_{27}O_3N_3$ has been proposed.[5]

Finally, lysergic acid was discovered and so named by us[6] a little more than two years ago. Since then the investigation of its structure as well as synthetic attempts have been in progress in this laboratory, and such work is being actively continued.

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Lyman C. Craig
Alexandre Rothen
The Rockefeller Institute for Medical Research,
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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A NEW APPARATUS FOR THE DAYLIGHT PROJECTION OF MICROSCOPIC AND LANTERN SLIDES

The reflecting box (Fig. 1) which is here described was developed about a year ago in our laboratory after a brief period of experimentation with various types of reflectors and reflecting surfaces. We regard it as the most satisfactory apparatus for daylight projection which we have used.

It has proven to be very useful in demonstrating and describing the detail of histological or zoological slides to small groups of students during laboratory exercises. By means of this apparatus (Fig. 1) any structure on a microscopic slide can be pointed out, emphasized and described. It enables the instructor to be certain that each student actually sees the structures under consideration. It permits of a full discussion and demonstration of any given cell or tissue by manipulating the mechanical stage of the projecting machine so that the cell or tissue under consideration is placed at the end of an arrow which is drawn on the reflecting surface (S, Fig. 1).

Ten or a dozen students can view the image to advantage at one time by standing around the table on which the projecting machine and reflecting box are placed.

This reflecting box can, also, be used to advantage in daylight projection of lantern slides with a delineascope. Photographs or plates from texts can, likewise, be shown in daylight with the delineascope; but they are not as clear as lantern slides.

The great advantage of this apparatus is that it can be used during the daytime in the laboratory, even with lights on and without shading the windows. For best results light should not shine directly into the box and the apparatus should be placed in the darkest portion of the room.

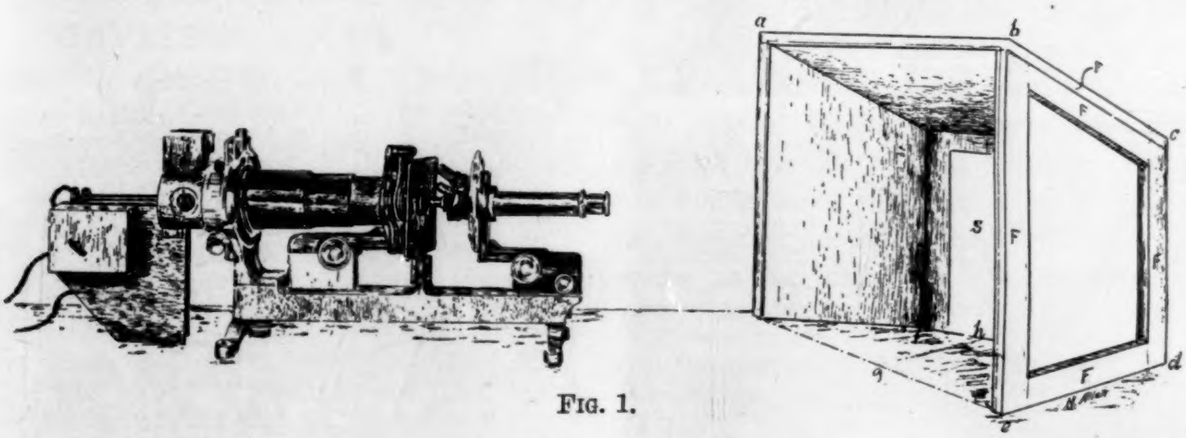

Fig. 1.

The basic idea of this reflecting box apparatus

[5] M. S. Kharasch and R. R. Legault, *Jour. Am. Chem. Soc.*, 57: 1140, 1935.

[6] W. A. Jacobs and L. C. Craig, *Jour. Biol. Chem.*, 104: 547, 1934.

(Fig. 1) is the projection of an image by a micro-projector or delineascope onto a piece of glazed or aluminum coated paper (S, Fig. 1) which is affixed to the inside of the deep end of the reflecting box. The interior of the box is painted a deep black. The sides of the box are sloping, so as to give the observers a better opportunity to view the image.

The reflecting box was constructed out of a preparation board (wall board), ¼″ thick, and was made with tight joints inside. The framing (F, Fig. 1) is all outside and was made of ¾″ × 2½″ pieces with lapped corners, nailed. (It could be so constructed as to fold up when not in use.) The inside dimensions of the box, which can be varied, are as follows (Fig. 1): front width, open end, ab, 30″; back width, closed end, df, 19¾″; front height, open end, be, 24¾″; back height, closed end, cd, 19¾″; direct open depth, gh, 17¼″; de, 18″; bc, 18½″. The drawing is not made to scale and the dimensions, as given, are all inside, even though some letters are placed outside the box for facility in drawing.

It might, also, be possible to modify the plan of this box and the method of observation of the image by building two boxes similar to the one described above, except that the two boxes, which would be placed back to back, would have a common partition between them. Then, by cutting an aperture in the common partition between the deep ends of the two boxes thus placed, and by covering this aperture with a translucent linen screen or with other translucent material, it might be possible to view the image through the open end of the box which faces away from the projector.

HOVEY JORDAN

THE UNIVERSITY OF VERMONT

FORCEPS DESIGNED FOR SKIN SUTURING[1]

IN suturing together skin edges after incisions for operations on laboratory animals such as guinea pigs and albino rats, it is often extremely difficult to penetrate the skin with the needle. When the skin edge is caught in the ordinary forceps, the skin tends to be pushed around the side of the forceps and the needle can not thus retain its right angle approach. It has been our custom to use Keith needles, which must be very sharp to pierce the tough dorsal skin in flank operations on the rodents mentioned above.

In using the forceps described herewith (see cuts), either one or both edges of the skin may be caught and the needle put through with ease, after which the forceps can be easily removed, the needle passing through the opening leading outward from the needle hole. Fig. 1 depicts an adaptation of an ordinary forceps, which has been found to work perfectly well. Fig. 2 is the proposed design of forceps of this type for the trade.

G. LOMBARD KELLY

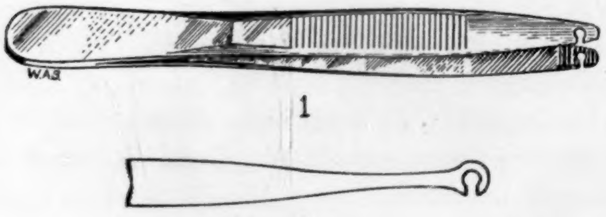

FIG. 1.

[1] From the Department of Anatomy, University of Georgia School of Medicine, Augusta, Georgia.

A NOTE ON LEVEL CONTROL IN FUNNELS

IN a recent issue of SCIENCE, Wean[1] has described, with an excellent illustration, a flow control system which is almost an exact replica of an apparatus used by the writer during the world war for control of level in a funnel in filtration of solutions made from $Ca(OCl)_2$ suspension and Na_2CO_3 in preparation of Dakin's hypochlorite solution. The apparatus was demonstrated to classes at the War Demonstration Hospital on the Rockefeller Institute grounds in New York City, but was made obsolete for the purpose by the chlorine gas method. While in no way wishing to detract from Wean's contribution, it may be worth while to record this other use as such need may occur again. The device has been used also in the writer's laboratory to control level in water thermostats. It is particularly valuable where suspended matter might clog a float-operated valve. The use of a Hoffman clamp on the return air-line for adjustments is sometimes helpful to minimize surges.

WILLIAM R. THOMPSON

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[1] R. E. Wean, SCIENCE, 82: 336, 1935.

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